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212. (New) The method of Claim ⁸⁷200 wherein the electroplating power is applied as a direct current.

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213. (New) The method of Claim ⁸⁷200 wherein the electroplating power is initially applied at a first current for a predetermined first period of time, then applied at a higher second current for a predetermined second period of time.

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214. (New) The method of Claim ⁸⁷200 wherein the workpiece is spun while electroplating power is applied.

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215. (New) The method of Claim ⁸⁷200 further comprising removing the excess copper after the workpiece is subjected to the elevated temperature annealing process.

REMARKS

The present Amendment amends 36, 143, 153 and 156; cancels claims 38, 39, 68-70, 72, 74, 76-116, and 183-185; and adds new claims 186-215. Upon entry of the present amendment, claims 36, 37, 40, 71, 73, 75, 117-182, and 186-215 will remain in the application.

Most of the changes in claims 143, 153, and 156 correct minor typographical errors, though claim 143 has been broadened by removing the term "predetermined." The changes in these claims are, therefore, either broadening amendments or cosmetic, non-narrowing changes and should be viewed accordingly.

In the Office Action mailed 20 December 2001, the Examiner rejected claims 36, 37, 68-116, and 183-185; indicated claims 38 and 39 would be allowable if presented in independent form; and allowed the remaining claims. While the undersigned disagrees with the stated rejections of claims 68-116 and 183-185, these claims have been canceled. Applicant reserves the right to pursue the subject matter of these dependent claims in a continuing application, though. Claim 36 has been amended to generally correspond to prior claim 38, and claim 37 depends from claim 36. Consequently, none of the claims rejected by the Examiner remain in the application.

Hence, the present amendment places the application in condition for allowance, prompt notice of which is courteously solicited. If the Examiner has any questions or would like to discuss any aspect of this application, the undersigned would welcome a call at 206.264.3848.

Respectfully submitted,

Perkins Coie LLP



Edward Hotchkiss
Registration No. 33,904

Enclosures:

Postcard

PTO-1083 (+ copy)

Appendix (Marked-up version of claims)

PERKINS COIE LLP

P. O. Box 1247

Seattle, Washington 98111-1247

(206) 583-8888

FAX: (206) 583-8500

Appendix

Claims Marked To Show Changes

Claims 36, 143, 153 and 156 have been amended as follows:

36. (Amended) A method for reducing voids in a metal material that has been electrolytically deposited into recessed microstructures defined in a surface of a microelectronic workpiece comprising:

electrolytically depositing a metal to substantially fill recessed sub-micron structures in the surface of the workpiece; and then

subjecting the workpiece to an annealing process at a temperature that is at or below about 250 degrees Celsius, the workpiece being subjected to a controlled temperature gradient in which the temperature decreases along a cross-section of the workpiece in a direction that is opposite to the direction of formation of the metal material during its deposition.

143. (Amended) A method of treating a microelectronic workpiece having a base having a surface including a sub-micron recessed microstructures, comprising:

contacting the surface of the workpiece with a copper-containing electroplating solution;

applying electroplating power at a first power level for a ~~predetermined~~ first period of time, then applying electroplating power at a higher second power level for a time sufficient to substantially fill the recessed sub-micron structures with electroplated copper metal and to deposit excess copper metal above the sub-micron recessed microstructures; then

subjecting the electroplated workpiece to an elevated temperature annealing process comprising establishing a temperature gradient through the electroplated copper metal in which the temperature decreases in a direction moving outwardly from the base toward the workpiece surface, the annealing process having a maximum gradient temperature which is no greater than about 250 degrees Celsius.

153. (Amended) The method of Claim 152 wherein the frequency of the ~~pulsed~~ pulsed waveform is between 5 and 20 Hz with a duty cycle of at least 50 percent.

154. (Amended) A method of treating a microelectronic workpiece having a base having a surface including a sub-micron recessed microstructures, comprising:

contacting the surface of the workpiece with a copper-containing electroplating solution;

applying electroplating power to the workpiece in a pulsed waveform having a frequency of between about 1 and 1000 Hz to substantially fill the recessed sub-micron structures with electroplated copper metal and to deposit excess copper metal above the sub-micron recessed microstructures; then

subjecting the electroplated workpiece to an elevated temperature annealing process comprising establishing a temperature gradient through the electroplated copper in which the temperature decreases in a direction moving outwardly from the base toward the surface of the workpiece, the temperature gradient having a maximum gradient temperature which is no greater than about 250 degrees Celsius.